IN THE SPECIFICATION

Please amend the paragraph beginning at page 4, line 22, and ending at page 5, line 9, as follows.

Furthermore, in order to attain the above-described object, an exposure apparatus according to another aspect of the present invention has the following configuration. More specifically, there is provided an exposure apparatus comprising: a first barometer for detecting an absolute value of air pressure; a second barometer for detecting an absolute value or a relative value of air pressure at a higher speed than the first barometer; calibration means for calibrating an output of the second barometer based on an output of the first barometer, and outputting a calibration result as a measured air pressure value; and aberration correction means for performing aberration correction based on the air pressure value outputted by the calibration means.

Please amend the paragraph beginning at page 6, line 2, and ending at line 17, as follows.

Furthermore, in order to attain the above-described object, an aberration correction method according to another aspect of the present invention is a method of correcting an aberration caused by a change in air pressure in an exposure apparatus,

comprising: a calibration step of calibrating an output of a second barometer based on an output of a first barometer and outputting a calibration result as a measured air pressure value, the first barometer detecting an absolute value of air pressure and the second barometer detecting an absolute value or a relative value of air pressure at a higher speed than the first barometer; and an aberration correction step of performing aberration correction based on the air pressure value outputted in the calibration step.

Please amend the paragraph beginning at page 6, line 18, and ending at line 23, as follows.

Other features and advantages of the present invention will be apparent from the following ~~descriptions~~ description taken in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures thereof.

Please amend the paragraph beginning at page 9, line 3, and ending at line 6, as follows.

For the exposure light source 80, a KrF or an ArF laser light source is often used. The exposure light source 80 and illumination optical system 90 can be expressed by a simplified structure shown in Fig. 9.

Please amend the paragraph beginning at page 9, line 7, and ending at line 24, as follows.

The exposure light source 80 and illumination optical system 90 are described with reference to Fig. 9. The exposure light source 80 comprises a laser resonator 82, a transmitting mirror 84, a wavelength selecting element 86, and a wavelength selecting element driving mechanism 88. With the use of at least one of a prism, a grating, and an etalon as the wavelength selecting element 86, the wavelength band can be narrowed. By changing an angle of the wavelength selecting element 86 using the wavelength selecting element driving mechanism 88, the wavelength of a laser beam can be changed. The wavelength selecting element driving mechanism 88 can be configured with a step motor, a piezoelectric ~~device~~ device, or the like. The laser beam emitted from the exposure light source 80 transmits through a condensing lens 92 of the illumination optical system 90, ~~thereafter~~ and thereafter, the mirror 94 leads the laser beam to irradiate the reticle.

Please amend the paragraph beginning at page 9, line 25, and ending at page 10, line 10, as follows.

The description continues referring back to Fig. 1. A laser driving unit 70 can change the wavelength of a laser beam of the exposure light source 80 by driving the wavelength selecting element driving mechanism 88 shown in Fig. 9. A lens driving unit

50 displaces the lens 104 with respect to the optical axis direction by driving a lens driving mechanism 100. The lens driving mechanism 100 can be configured with an actuator employing air pressure, or a piezoelectric ~~device~~ device, or the like. Note, although the first embodiment shows only one system of a lens driving mechanism, a plurality of lens driving mechanisms may be included.

Please amend the paragraph beginning at page 10, line 15, and ending at page 11, line 2, as follows.

A barometer 120 measures air pressure in the exposure apparatus. The barometer 120 may be arranged in any place of the exposure apparatus, or in the neighborhood of the projection optical system 101, or in the internal portion of the projection optical system 101. An output signal of the barometer 120 is inputted to a correction calculation unit 10. Based on the measurement value inputted by the barometer 120, the correction calculation unit 10 instructs the laser driving unit 70 to change the wavelength of the laser beam, instructs the lens driving unit 50 to drive the lens in the optical axis direction, and instructs the stage driving unit 65 to drive the stage in the Z direction, thereby correcting an aberration caused by a change in air pressure.

Please amend the paragraph beginning at page 11, line 6, and ending at page 12, line 2, as follows.

Fig. 2 shows a construction of the correction calculation unit 10. A model calculation unit 20 compensates for a response error between the air pressure data measured by the barometer 120 and ambient pressure of the lenses 102, 104, 106, 108 and 110 in the projection optical system 101. In general, the ambient pressure of the lenses in the projection optical system has a primary delay characteristic in response to a change in air pressure in the exposure apparatus. For this reason, in a case where the barometer 120 is arranged in the external portion of the projection optical system, an air pressure characteristic of the barometer 120 and ambient pressure characteristics of the lenses are measured in advance and a model is generated. The model calculation unit 20 refers to this model to compensate for the measured value of the barometer 120, and obtains ambient pressure of the lenses. In a case where the barometer 120 is arranged in the internal portion of the projection optical system, the model calculation unit 20 can be omitted since a response error is small. Note that if the barometer 120 has a large detection noise, smoothing such as ~~filtering~~ filtering, or the ~~like~~ like, may be performed as needed.

Please amend the paragraph beginning at page 21, line 2, and ending at line 8, as follows.

The aberration correction calculation unit 32 calculates a lens driving amount for correcting m number of aberrations by displacing m groups of lenses with respect to the optical-axis direction. Note that m is the number of <u>the</u> group larger than 1, and is smaller than <u>the</u> n group which is used in the shot-interval correction.

Please amend the paragraph beginning at page 25, line 24, and ending at page 26, line 3, as follows.

Next, the second embodiment is described. In the first embodiment, the aberration correction operation is switched ~~for~~ during a shot interval and ~~for~~ during a shot. In the second embodiment, an aberration correction operation is switched for performing the correction at long time intervals and for performing the correction at short time intervals.

Please amend the paragraph beginning at page 29, line 4, and ending at line 11, as follows.

Fig. 4 shows a configuration of an exposure apparatus according to the third embodiment of the present invention. With respect to the components that perform similar operation to that of the first embodiment (Fig. 1), the same reference numerals are assigned and a description thereof is omitted. Hereinafter, the components different from the first embodiment are described.

Please amend the paragraph beginning at page 29, line 12, and ending at line 17, as follows.

In the third embodiment (Fig. 4), a new barometer 122 is added to the construction shown in Fig. 1, and a correction calculation unit 10a is provided. For convenience of explanation, the barometers 120 and 122 will be referred to as the first barometer and second ~~barometer~~ barometer, respectively.

Please amend the paragraph beginning at page 29, line 18, and ending at page 30, line 12, as follows.

The first barometer 120 measures an absolute value of air pressure with high precision (a barometer having a calibration function performing calibration according to the environment). The second barometer 122 measures an absolute value or a relative value of air pressure at a higher speed than the first barometer. Although the first barometer for measuring an absolute value of air pressure can measure air pressure with a high precision without receiving an influence of the temperature or humidity, because it outputs an air pressure measurement value after removing an influence of the temperature or humidity, the response speed as a sensor is low. On the contrary, since the second barometer for measuring an absolute value or a relative value of air pressure performs air pressure measurement by a wavelength tracker which is configured with, e.g., a laser interferometer, the response speed is extremely high. The wavelength tracker is a measuring equipment that measures a medium, i.e., a refractive index of air, by making use of a laser beam, and outputs a refractive index of air pressure, temperature and humidity at high speed.

Please amend the paragraph beginning at page 31, line 24, and ending at page 32, line 9, as follows.

In general, the temperature in the interior of the exposure apparatus is controlled with the precision of approximately ~~0.01 C°~~ 0.01 °C or less for maintaining the precision of the apparatus. Since the temperature fluctuation is sufficiently small, the measurement error of the wavelength tracker caused by the temperature fluctuation can be disregarded. However, it is often the case that the humidity is not actively controlled, ~~thus~~ thus, a slight and gradual fluctuation in humidity may occur. In such a case, as is apparent from equations (9) and (10), the humidity fluctuation causes a change in the refractive index outputted from the wavelength tracker, generating a barometric error.

Please amend the paragraph beginning at page 32, line 17, and ending at page 33, line 11, as follows.

In view of the above, the third embodiment comprises as the first barometer 120 a barometer which has a low response speed but detects an absolute value of air pressure without receiving an influence of the temperature or humidity, and comprises as the second barometer 122 a barometer which detects an absolute value or a relative value of air pressure at a high speed and which easily receives an influence of the temperature or humidity. By utilizing an output from the first barometer 120 which has a low response

speed but can detect an absolute value of air pressure with high precision, calibration is performed on an output from the second barometer 122 which has a high response speed but is sensitive to an environmental change other than air pressure such as humidity. By virtue of this, a slight or sudden change in air pressure during an exposure or in the non-exposure state can be detected at high speed with high precision, and an aberration caused by the change in air pressure can be corrected in real time. Accordingly, it is possible to realize an exposure apparatus capable of performing exposure with high precision.

Please amend the paragraph beginning at page 33, line 12, and ending at line 19, as follows.

Fig. 5 shows a construction of the correction calculation unit 10a according to the third embodiment. With respect to the components that perform similar operation to the correction calculation unit 10 (Fig. 2) of the first embodiment, the same reference numerals are assigned and a description thereof is omitted. A calibration calculation unit 18 is newly added to the correction calculation unit 10a.

Please amend the paragraph beginning at page 34, line 15, and ending at page 35, line 14, as follows.

The averaging time of the averaging units 12 and 14 may range from tens of seconds to several minutes or from tens of minutes to several hours. For instance, if there is a possibility that the humidity fluctuates within several minutes to tens of minutes, respective air pressure data ~~is~~ are averaged while exposure processing is performed for one wafer and an offset is calculated by the calculation unit 15 while the wafer is exchanged to update the value. Then, in the wafer exposure processing, the updated offset is used to calibrate the data from the second barometer 122. In this manner, each time one wafer is processed, an offset value serving as calibration data can be calculated and updated by the calculation unit 15 for calibration of the data outputted by the second barometer 122. If the humidity fluctuation is small, averaging processing is performed for approximately several minutes by the averaging units 12 and 14 when a reticle is exchanged or when the exposure apparatus is started. Then, an offset is calculated by the calculation unit 15 to update and maintain the value, and the calibration unit 16 performs calibration on the data from the second barometer 122.

Please amend the paragraph beginning at page 35, line 11, and ending at line 23, as follows.

As described above, the calibration calculation unit 18 employs the data outputted by the first barometer 120, which has <u>a</u> low response speed but can measure an absolute value of air pressure with high precision, to perform calibration on the data outputted by the second barometer 122, which has <u>a</u> high response ~~speed~~ <u>speed,</u> but causes a barometric error due to humidity ~~fluctuation~~ <u>fluctuation,</u> or the like. As a result, air pressure data can be obtained with high precision at <u>a</u> high response speed. The constructions of the model calculation unit 20 and other components shown in Fig. 5 are similar to ~~that~~ <u>those</u> of the first embodiment and second embodiment.

Please amend the paragraph beginning at page 36, line 25, and ending at page 37, line 16, as follows.

In particular, by virtue of the air pressure measurement according to the third embodiment, a slight or sudden change in air pressure during an exposure or in the non-exposure state can be detected at high speed with high precision, because the output from the first barometer ~~120~~ <u>120,</u> which has <u>a</u> low response ~~speed~~ <u>speed,</u> but can detect an absolute value of air pressure with high precision is employed to perform calibration on the absolute value or <u>a</u> relative value of air pressure outputted by the second barometer ~~122~~

122, which has a high response speed but is sensitive to an environmental change other than air ~~pressure~~ pressure, such as humidity. Accordingly, either the case where lenses of the projection optical system are configured with a single glass material or the case where the lenses are not configured with a single glass material, it is possible to correct in real time an aberration caused by a slight or sudden change in air pressure during an exposure or in the non-exposure state.

Please amend the paragraph beginning at page 40, line 7, and ending at line 27, as follows.

As has been set forth above, according to the fourth embodiment, in a case where the lenses of the projection optical system are configured with a single glass material, an aberration caused by a change in air pressure is corrected during a shot interval as well as in real time by changing a wavelength of exposure light. Particularly, by utilizing an output from the first barometer ~~120~~ 120, which has a low response speed but can detect an absolute value of air pressure with high precision, calibration is performed on an output from the second barometer 122 (an absolute value or a relative value of air ~~pressure)~~ pressure), which has a high response ~~speed~~ speed, but is sensitive to an environmental change other than air ~~pressure~~ pressure, such as humidity. By virtue of this, a slight or sudden change in air pressure during an exposure or in the non-exposure state can be detected at high speed with high precision. Accordingly, it is possible to realize an

exposure apparatus capable of correcting in real time an aberration caused by a change in air pressure and performing exposure with high precision.

Please amend the paragraph beginning at page 43, line 7, and ending at page 44, line 2, as follows.

The aberration correction calculation unit 28c according to the fifth embodiment calculates, regardless of whether it is during an exposure or in the non-exposure state, a lens driving amount and an exposure-light-wavelength changing amount (as well as the wafer stage driving amount in the optical-axis direction) necessary for correcting an aberration constantly caused by a change in air pressure. Particularly, by utilizing an output from the first barometer ~~120~~ 120, which has a low response ~~speed~~ speed, but can detect an absolute value of air pressure with high precision, calibration is performed on an output from the second barometer 122 (an absolute value or a relative value of air ~~pressure)~~ pressure), which has a high response ~~speed~~ speed, but is sensitive to an environmental change other than air ~~pressure~~ pressure, such as humidity. By virtue of this, a slight or sudden change in air pressure during an exposure or in the non-exposure state can be detected at high speed with high precision. Accordingly, it is possible to realize an exposure apparatus capable of correcting in real time an aberration caused by a change in air pressure and performing exposure with high precision.

Please amend the paragraph beginning at page 44, line 4, and ending at line 10, as follows.

<Application To A Semiconductor Manufacturing Apparatus>

Described next is an embodiment of a semiconductor device manufacturing method employing the above-described exposure apparatus. Fig. 10 shows a production flow of micro devices (e.g., semiconductor chips such as ~~an IC~~ ICs or ~~LSI,~~ LSIs, liquid crystal panels, ~~CCD,~~ CCDs, thin-film magnetic heads, micro machines, and so forth).

Please amend the paragraph beginning at page 44, line 11, and ending at page 45, line 2, as follows.

In step S101 (circuit design), a circuit of a semiconductor device is designed. In step S102 (mask production), a mask on which the designed circuit pattern is formed is produced. Meanwhile, in step S103 (wafer production), a wafer is produced with a material such as silicon. In step S104 (wafer process), which is called a pre-process, an actual circuit is formed on the wafer by a lithography technique using the mask and wafer prepared as described above. In step S105 (assembly), which is called a post-process, a semiconductor chip is manufactured using the wafer produced in step S104. Step S105 includes an assembling process (dicing, bonding), a packaging process (chip ~~embedding)~~ embedding), and so on. In step S106 (inspection), the semiconductor device manufactured

in step S105 is subjected to inspection such as an operation-check test, a durability ~~test~~ test, and so on. The semiconductor device manufactured in the foregoing processes is shipped (step S107).

Please amend the paragraph beginning at page 45, line 3, and ending at line 19, as follows.

Fig. 11 shows a flow of the aforementioned wafer process in detail. In step S111 (oxidization), the wafer surface is oxidized. In step S112 (CVD), an insulating film is deposited on the wafer surface. In step S113 (electrode forming), electrodes are deposited on the wafer. In step S114 (ion implantation), ~~ion is~~ ions are implanted on the wafer. In step S115 (resist process), a photosensitive agent is coated on the wafer. In step S116 (exposure), the circuit pattern of the mask is exposed on the wafer by the above-described exposure apparatus. In step S117 (development), the exposed wafer is developed. In step S118 (etching), portions other than the developed resist image are removed. In step S119 (resist separation), unnecessary resist after the etching process is removed. By repeating the foregoing steps, multiple circuit patterns are formed on the wafer.